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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/719,061	Applicant(s) KOGA ET AL.	
	Examiner Aristocratis Fotakis	Art Unit 2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 11/23/2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1 - 4, 6 - 16 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1 - 4, 6 - 16 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 11/24/2003 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "the sign of the odd-numbered real coefficient wavelet filters inverted" must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

The abstract of the disclosure is objected to because brackets are missing for each figure label component. Correction is required. See MPEP § 608.01(b).

Claim Objections

Claim 1 is objected to because of the following informalities: "SSB" needs to be defined in Line 1 of Page 5. Appropriate correction is required.

Claim 6 is objected to because of the following informalities: "LPF" needs to be defined in Line 4 of Page 8. Appropriate correction is required.

Claim 7 is objected to because of the following informalities: "LPF" needs to be defined in Line 9 of Page 9. Appropriate correction is required.

Claim 11 is objected to because of the following informalities: "SSB" needs to be defined in Line 13 of Page 13 and "LPF" needs to be defined in Line 1 of Page 14. Appropriate correction is required.

Claim 12 is objected to because of the following informalities: typing informality in line 1 of page 15 "*know* data". Appropriate correction is required.

Claim 15 is objected to because of the following informalities: "LPF" needs to be defined in Line 9 of Page 16. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1 – 4 and 7 - 10 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The nature of Applicant's invention relates to relates to a multicarrier transmitter for performing data transmission by way of digital modulation using a real coefficient wavelet filter bank, a multicarrier receiver for performing data reception by way of digital demodulation using a real coefficient wavelet filter bank, and multicarrier communications apparatus for performing data communications by way of digital modulation/demodulation using a real coefficient wavelet filter bank. In order for this function to occur one of the requirements of independent claims 1 and 7 is to have a second inverse wavelet transformer where Hilbert transform has been made, with the sign of the odd-numbered real coefficient wavelet filters inverted. In reviewing the

specification or the Figures there was no guidance to allow of one of skill in the art to practice the recited inversion, since no information was provided on inverting the sign of the odd-numbered real coefficient wavelet filters. Therefore, it would be unpredictable to practice Applicant's claimed invention and therefore require an undue amount of experimentation to make and use the claimed invention.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 7 and 9 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 - 6 of U.S. Patent No. 7,164,724

in view of Xie et al ("*A combined DMT/DWMT system for DSL application*", University of Singapore, Indian Institute of Science, Signal Processing 80 (2000) 185 – 195, 2000 Elsevier Science B.V).

Re claim 7:

Claims 1 and 5 of 7,164,724, recite of a multicarrier receiver for performing data reception by way of digital multicarrier demodulation using a real coefficient wavelet filter bank, said multicarrier receiver comprises: a multiplier for downconverting a received bandpass signal to a baseband signal; a local oscillator for providing said multiplier with a signal of a predetermined frequency (*demodulation*, preamble of claim 1); a first wavelet transformer for performing a first wavelet transform on an output signal from said LPF (claim 1); a second wavelet transformer for performing Hilbert transform on the real coefficient wavelet filters of said first wavelet transformer (claim 1), said second wavelet transformer including said real coefficient wavelet filters of the first wavelet transformer where Hilbert transform has been made, with the sign of said odd-numbered real coefficient wavelet filters inverted (claim 5), said second wavelet transformer performing a second wavelet transform on an output signal; an equalizer for equalizing each parallel signal of an in-phase signal output from said first wavelet transformer and an orthogonal signal output from said second wavelet transformer as a complex signal of each subcarrier (claim 1). However, the claims of 7,164,724 do not recite of a LPF for removing an unwanted signal outside the band of baseband signal output from said multiplier; parallel-to-serial converter for converting an equalized

parallel signal output from said equalizer to serial data; and a determination unit for determining serial data output from said parallel-to-serial converter.

Xie teaches of a combined DMT/DWMT system for DSL application. The receiver comprises of a lowpass filter, a first wavelet transformer, an equalizer (post-detection and pre-detection equalizer, Fig.5), a parallel to serial converter and a determination unit (decoder and b(RT) bit buffer, Fig.5). Xie teaches of an equalizer for equalizing each parallel signal of an in-phase signal and an orthogonal signal output from said first wavelet transformer as a complex signal of each subcarrier (Fig.5, Page 190). Xie also teaches of the first wavelet transformer comprising: M-1 single sample delay elements for inputting an in-phase signal and an orthogonal signal output from said LPF (Fig.4, Z^{-1}); M downsamplers for inputting output data of said single sample delay elements (Fig.4); a first prototype filter for inputting output data of said M downsamplers (Fig.4, r_0 – r_{2M-1}, equation 8, Page 189), ; and a high-speed discrete cosine transformer for inputting output data of said first prototype filter (IFFT and Page 189, equations 6 – 7).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used a LPF to clean the signal after demodulation, to have equalized the complex signal from the wavelet transformer to enable a high rate operation for the wireless channels and to have serialized the signal in order for a decoder to restore the data to its original form.

Re claim 9:

Claim 5 of 7,164,724, recite of wherein said second wavelet transformer comprises: M-1 single sample delay elements for inputting an output signal of said LPF; M downsamplers for inputting output data of said single sample delay elements; a second prototype filter for inputting output data of said M downsamplers; and a high-speed discrete sine transformer for inputting output data of said second prototype filter.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein

were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 6 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kjeldsen et al (US PG-Pub 20030231714) in view of Xie et al ("*A combined DMT/DWMT system for DSL application*", University of Singapore, Indian Institute of Science, Signal Processing 80 (2000) 185 – 195, 2000 Elsevier Science B.V).

Kjeldsen teaches of a multicarrier receiver for performing data reception by way of digital multicarrier demodulation using a real coefficient wavelet filter bank, said multicarrier receiver (Figs 1 and 7) comprises: a first multiplier and a second multiplier for downconverting a received bandpass signal to a baseband signal (Fig.1, WPM Receiver, Paragraph 0068); a local oscillator for providing said first multiplier with a signal of a predetermined frequency (shown in Fig.1, Paragraph 0068); a $\pi/2$ phase shifter for delaying the phase of said local oscillator by $\pi/2$ to generate a carrier orthogonal to said second multiplier (shown in Fig.1, Paragraph 0068); a first LPF and a second LPF for removing an unwanted signal outside the band of a baseband signal output from each of said first and said second multipliers (anti-aliasing filter, Fig.6, Paragraph 0069, *An anti-aliasing filter is known to be a low-pass filter that's used to*

prevent higher frequencies, in either the signal or noise, from introducing distortion into the digitised signal); a first wavelet transformer for performing wavelet transform on an in-phase signal and an orthogonal signal output from each of said first LPF and said second LPF (#132, DWPT, Figs.1 and 7, Paragraph 0075); a parallel-to-serial converter for converting a parallel signal output from said equalizer to a serial signal (Multiplexer MUX, #136, Fig.1, Paragraph 0014 and 0077); and a determination unit for determining serial data output from said parallel-to-serial converter (Complex Symbol Detection, Paragraph 0077, Fig.1). However, Kjeldsen does not specifically teach of an equalizer for equalizing each parallel signal of an in-phase signal and an orthogonal signal output from said first wavelet transformer as a complex signal of each subcarrier and the configuration of the first wavelet transformer.

Xie teaches of a combined DMT/DWMT system for DSL application. The receiver comprises of a lowpass filter, a first wavelet transformer, an equalizer (post-detection and pre-detection equalizer, Fig.5), a parallel to serial converter and a determination unit (decoder and b(RT) bit buffer, Fig.5). Xie teaches of an equalizer for equalizing each parallel signal of an in-phase signal and an orthogonal signal output from said first wavelet transformer as a complex signal of each subcarrier (Fig.5, Page 190). Xie also teaches of the first wavelet transformer comprising: M-1 single sample delay elements for inputting an in-phase signal and an orthogonal signal output from said LPF (Fig.4, Z^{-1}); M downsamplers for inputting output data of said single sample delay elements (Fig.4); a first prototype filter for inputting output data of said M downsamplers (Fig.4, r_0 – r_{2M-1}, equation 8, Page 189), ; and a high-speed discrete

cosine transformer for inputting output data of said first prototype filter (IFFT and Page 189, equations 6 – 7).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have equalized the complex signal from the wavelet transformer to enable a high rate operation for the wireless channels. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the wavelet transformer configuration of Xie to introduce immunity to narrowband interference without adding complexity to the system.

Claims 11 and 14 - 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandberg et al. (US 5,715,280) in view of Xie et al.

Re claim 14, Sandberg teaches of a multicarrier transmitter for performing data transmission by way of digital multicarrier modulation using a real coefficient filter bank, said multicarrier transmitter (Fig. 3) comprising:; a serial-to-parallel converter for converting serial data as said symbol mapped series of information to parallel data (#301, Fig.3); a first wavelet transformer for performing a first transform on said parallel data (#302, Fig.3 and Col 1, Lines 25 – 30 and 47 - 62); a second wavelet transformer for performing a second transform on said parallel data (#312, Fig.3); and a modulator for performing modulation by using the output from said first wavelet transformer as an in-phase signal of complex information and the output from said transformer as an orthogonal signal of complex information (SSB modulation, Fig.3) (Col 6, Lines 34 – 67

to Col 7, lines 1 – 35, Fig.3). However, Sandberg does not specifically teach of a signal point mapping unit for performing symbol mapping of a series of information and the first and second transformer being an inverse wavelet transformation including a plurality of real coefficient wavelet filters.

Xie teaches of a combined DMT/DWMT system for DSL application. The transmitter comprises of a serial to parallel converter (buffer and encoder, Fig.5), a wavelet transformer and a lowpass filter. Xie teaches of a signal point mapping unit for performing symbol mapping of a series of information (QAM, Page 188, Paragraph 1, Col 2) and the first and second inverse wavelet transformer both including a plurality of real coefficient wavelet filters (equation 4).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used a symbol mapper to include the I and Q components to be processed in the receiver and to clearly show that the cosine modulation of Sandberg (Col 6, Lines 50 – 67) that both the first and second inverse wavelet transformer would including a plurality of real coefficient wavelet filters to improve the orthogonality of the signal.

Re claim 15, Sandberg teaches of a multicarrier receiver for performing data reception by way of digital multicarrier demodulation using a real coefficient wavelet filter bank, said multicarrier receiver (Figs.2 and 3) comprising: a multiplier for downconverting a received bandpass signal to a baseband signal (Abstract, Fig.2); a local oscillator for providing said multiplier with a signal of a predetermined frequency

(demodulation, Col 5, Lines 8 – 18); a LPF for removing an unwanted signal outside the band of baseband signal output from said multiplier (#202, 212, Fig.2); a wavelet transformer for performing a wavelet transform on an output signal from each said LPF (#221, Fig.2 and #342, Fig.3 and Col 1, Lines 25 – 30 and 47 - 62); an equalizer for equalizing each parallel signal of an in-phase signal output and an orthogonal signal output from said transformer as a complex signal of each subcarrier (#124, Fig.1); a parallel-to-serial converter for converting an equalized parallel signal output from said equalizer to serial data (#126, *the parallel signal from the equalized FFT would have to be serialized for the decoder to decode the signal*); determination unit for determining serial data output from said parallel-to-serial converter (#128, Fig.1, Col 4, Lines 25 – 67). However, Sandberg does not specifically teach of a first and second wavelet transformer (instead of one transformer) being a wavelet transformation including a plurality of real coefficient wavelet filters.

Sandberg does not specifically disclose two separate transformers in the receiver side. However, Sandberg teaches of a group of K symbols that can be inserted onto a communication link by using a transmitter that performs the reverse of the operations described above with respect to receiver (#200).

Xie teaches of a combined DMT/DWMT system for DSL application. The receiver comprises of a lowpass filter, a first wavelet transformer, an equalizer (post-detection and pre-detection equalizer, Fig.5), a parallel to serial converter and a determination unit (decoder and b(RT) bit buffer, Fig.5). Xie teaches of the wavelet transformer including a plurality of real coefficient wavelet filters (equation 4).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have a receiver that performs the reverse operation of the transmitter to clearly show the two separate transformers for simplicity reasons. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used to have used cosine modulation/demodulation to clearly show that the cosine demodulation of Sandberg (Col 6, Lines 50 – 67) that both the first and second inverse wavelet transformer would include a plurality of real coefficient wavelet filters to improve the orthogonality of the signal.

Re claim 16, Sandberg and Xie together teach of a multicarrier communications apparatus comprising the multicarrier transmitter (according to claim 14) and a multicarrier receiver for performing data reception by way of digital multicarrier demodulation using a real coefficient wavelet filter bank, said multicarrier receiver comprising: a multiplier for downconverting a received bandpass signal to a baseband signal; a local oscillator for providing said multiplier with a signal of a predetermined frequency; an LPF for removing an unwanted signal outside the band of baseband signal output from said multiplier; a first wavelet transformer for performing a first wavelet transform on an output signal from said LPF, said first wavelet transformer including a plurality of real coefficient wavelet filters; a second wavelet transformer for performing a second wavelet transform on the output signal from said LPF, said second wavelet transformer including a plurality of real coefficient wavelet filters; an equalizer for equalizing each parallel signal of an in-phase signal output from said first wavelet

transformer and an orthogonal signal output from said second wavelet transformer as a complex signal of each subcarrier; a parallel-to-serial converter for converting an equalized parallel signal output from said equalizer to serial data; and a determination unit for determining serial data output from said parallel-to-serial converter, wherein: said multicarrier communications apparatus performs data transmission by way of digital multicarrier modulation/demodulation using a real coefficient wavelet filter bank (see rejections of claims 14 and 15).

Re claim 11, Sandberg and Xie together teach of a multicarrier communications apparatus comprising a multicarrier transmitter and a multicarrier receiver, said multicarrier communications apparatus performing data transmission by way of digital multicarrier modulation/demodulation using a real coefficient wavelet filter bank including M real coefficient wavelet filters (M being a positive integer), said multicarrier communications transmitter comprising: a signal point mapping unit for converting bit data to symbol data to map said symbol data on M/2 complex coordinate planes; a serial-to-parallel converter for converting serial data as said mapped symbol data to parallel data; a first inverse wavelet transformer comprising said M real coefficient wavelet filters orthogonal to each other, said first inverse wavelet transformer outputting an in-phase signal of said complex data; a second inverse wavelet transformer comprising said M real coefficient wavelet filters orthogonal to each other, said second inverse wavelet transformer outputting an orthogonal signal of said complex data; and an SSB modulator for performing SSB modulation (Col 6, Lines 55 – 57) by using the

output from said first inverse wavelet transformer as an in-phase signal of complex information and the output from said second inverse wavelet transformer as an orthogonal signal of complex information; and wherein a detector of said multicarrier receiver comprises: a multiplier for downconverting a received bandpass signal as a receive signal of a received bandpass signal to a baseband signal; a local oscillator for providing said multiplier with a signal of a predetermined frequency; a LPF for removing an unwanted signal outside the band of a baseband signal output from said multiplier; a first wavelet transformer comprising M real coefficient wavelet filters orthogonal to each other, said first wavelet transformer inputting the output data from said LPF (as discussed above in claims 14 – 16).

However, Sandberg does not specifically teach of a complex data decomposer for inputting said parallel data as well as decomposing complex data into a real part and an imaginary part so as to supply an in-phase component of complex information to the (2n-1)th input to said first and said second inverse wavelet transformers and supply an orthogonal component to the 2nth input (where $1<n<(M/2-1)$), a subcarrier number is 0 to M-1) and a complex data generator for generating complex data by using the (2n-1)th output from said first wavelet transformer as an in-phase component of complex information and 2nth output as an orthogonal component (where $1 <n<(M/2-1)$), a subcarrier number is 0 to M-1).

Xie teaches of a complex data decomposer for inputting said parallel data as well as decomposing complex data into a real part and an imaginary part so as to supply an in-phase component of complex information to the (2n-1)th (n is k, Page 188, Col 2)

input to inverse wavelet transformer and supply an orthogonal component to the 2nth input (where 1<n<(M/2-1)) (Page 188, Col 2), a subcarrier number is 0 to M-1) and a complex data generator for generating complex data by using the (2n-1)th output from said first wavelet transformer as an in-phase component of complex information and 2nth output as an orthogonal component (where 1 <n<(M/2-1)), a subcarrier number is 0 to M-1) (Figs 3 – 5, Pages 188 – 189).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the inverse wavelet and wavelet transformer configuration of Xie including the data decomposing and composing to introduce immunity to narrowband interference without adding complexity to the system.

Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sandberg and Xie in view of Smart et al (US 2002/0041637).

Sandberg and Xie teach all the limitations of claim 11, as well as Sandberg further teaching of the multicarrier communications transmitter comprising of a synchronization data generator for generating a signal as data known to said multicarrier receiver and the multicarrier transmitter as a modulator for inputting said signal as known data from said synchronization data generator (symbol generator, transmitter Clock #107 and receiver clock #133, Col 4, Lines 10 – 20). However, Sandberg and Xie do not specifically teach of the multicarrier receiver comprising: the detector for outputting adjacent complex subcarrier data including a subcarrier pair and

a synchronization estimation circuit for estimating symbol synchronization timing from the difference between said adjacent complex subcarrier data items.

Smart teaches of a multicarrier receiver (Fig.15) comprising: the detector for outputting adjacent complex subcarrier data including a subcarrier pair (Paragraph 0028) and a synchronization estimation circuit for estimating a symbol synchronization timing from the difference between said adjacent complex subcarrier data items (*sliding window receiver*, Paragraphs 0196 – 0197 and 0223).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used a sliding window system to provide good orthogonality between adjacent subcarriers for improving the bandwidth efficiency of the communication system.

Claims 1 – 4 and 7 – 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandberg in view of Xie and further in view of Kingsbury ("*Complex Wavelets for Shift Invariant Analysis and Filtering of Signals*" University of Cambridge, UK, 2001, Academic Press).

Re claim 1, Sandberg and Xie teach of a multicarrier transmitter for performing data transmission by way of digital multicarrier modulation using a real coefficient wavelet filter bank, said multicarrier transmitter comprises: a signal point mapping unit for performing symbol mapping of a series of information; a serial-to-parallel converter

for converting serial data as said symbol mapped series of information to parallel data; a first inverse wavelet transformer including a plurality of real coefficient wavelet filters orthogonal to each other, said first inverse wavelet transformer performing a first inverse wavelet transform on said parallel data; a second inverse wavelet transformer including: real coefficient wavelet filters of said first inverse wavelet transformer where Hilbert transform (Sandberg, *Hilbert transform*, Col 6, Lines 61 – 64) has been made, said second inverse wavelet transformer performing a second inverse wavelet transform on said parallel data; and a modulator for performing SSB modulation (SSB, Col 6, Lines 55 – 58, reference or Sandberg) by using the output from said first inverse wavelet transformer as an in-phase signal of complex information and the output from the second inverse wavelet transformer as an orthogonal signal of complex information (Please see rejection of claim 14). However, Sandberg and Xie do not specifically teach of the sign of the odd-numbered real coefficient wavelet filters being inverted.

Kingbury teaches of complex wavelets for shift invariance analysis and filtering of signals. Kingbury teaches of real coefficient wavelet filters of a first inverse wavelet transformer (wavelet trees, Fig.1, The Dual Filter Tree on Pages 235 – 237 and inverse DT CWT, Page 237, Paragraph 1) where Hilbert transform has been made (Page 241, Lines 9 – 30); with the sign of the odd-numbered (Fig.3) real coefficient wavelet filters being inverted (Page 238, Paragraphs 1 and 2), second inverse wavelet transformer performing a second inverse wavelet transform on the parallel data. (wavelet trees a and b, Q-shift).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the Q-shift dual tree of Kingsbury to possess good shift invariance properties, given suitably designed orthogonal wavelet filters.

Re claims 2 – 4, Sandberg, Xie and Kingbury teach all the limitations of claim 1 as well as Sandberg teaching the inverse wavelet transformers in the transmitter (Fig.3). However, Sandberg does not teach of the configuration of an inverse wavelet transformer.

Xie teaches of a combined DMT/DWMT system for DSL application. The transmitter comprises of a serial to parallel converter (buffer and encoder, Fig.5), a wavelet transformer and a lowpass filter. The inverse wavelet transformer comprises of a high-speed discrete cosine transformer (FFT, Fig.3) for inputting parallel data from the serial-to-parallel converter (parallel data as shown in Fig.3); a first prototype filter including a polyphase filter having a real coefficient ($p_0(n)$, Page 188, Col 2), said first prototype filter inputting output data of said high-speed discrete cosine transformer (Fig.3); M upsamplers for inputting output data of said first prototype filter (Fig.3); and M-1 single sample delay elements for inputting output data of said upsamplers (Fig.3, Z^{-1}).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the inverse wavelet transformer configuration of Xie to introduce immunity to narrowband interference without adding complexity to the system.

Re claim 7, Sandberg and Xie teach of a multicarrier receiver for performing data reception by way of digital multicarrier demodulation using a real coefficient wavelet filter bank, said multicarrier receiver comprises: a multiplier for downconverting a received bandpass signal to a baseband signal; a local oscillator for providing said multiplier with a signal of a predetermined frequency; an LPF for removing an unwanted signal outside the band of baseband signal output from said multiplier; a first wavelet transformer for performing a first wavelet transform on an output signal from said LPF; a second wavelet transformer for performing Hilbert transform on the real coefficient wavelet filters of said first wavelet transformer (Sandberg, *Hilbert transform*, Col 6, Lines 36 – 64), said second wavelet transformer including said real coefficient wavelet filters of the first wavelet transformer where Hilbert transform has been made, said second wavelet transformer performing a second wavelet transform on an output signal from said LPF; an equalizer for equalizing each parallel signal of an in-phase signal output from said first wavelet transformer and an orthogonal signal output from said second wavelet transformer as a complex signal of each subcarrier; a parallel-to-serial converter for converting an equalized parallel signal output from said equalizer to serial data; and a determination unit for determining serial data output from said parallel-to-serial converter. (Please see rejection of claim 15). However, Sandberg and Xie do not specifically teach of the sign of the odd-numbered real coefficient wavelet filters being inverted.

Kingbury teaches of complex wavelets for shift invariance analysis and filtering of signals. Kingbury teaches of real coefficient wavelet filters of a first wavelet

transformer (wavelet trees, Fig.1, The Dual Filter Tree on Pages 235 – 237 and DT CWT, Fig. 1) where Hilbert transform has been made (Page 241, Lines 9 – 30), with the sign of the odd-numbered (Fig.3) real coefficient wavelet filters being inverted (Page 238, Paragraphs 1 and 2), second wavelet transformer performing a second wavelet transform on the parallel data. (wavelet trees a and b, Q-shift).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the Q-shift dual tree of Kingsbury to possess good shift invariance properties, given suitably designed orthogonal wavelet filters.

Re claims 8 – 10, Sandberg, Xie and Kingbury teach all the limitations of claim 7 as well as Sandberg teaching the inverse wavelet transformers in the transmitter (Fig.3) and the wavelet transformation in the receiver side. However, Sandberg does not teach of the configuration of a wavelet transformer.

Xie teaches of a combined DMT/DWMT system for DSL application. The receiver comprises of a lowpass filter, a first wavelet transformer, an equalizer (post-detection and pre-detection equalizer, Fig.5), a parallel to serial converter and a determination unit (decoder and b(RT) bit buffer, Fig.5). Xie teaches of an equalizer for equalizing each parallel signal of an in-phase signal and an orthogonal signal output from said first wavelet transformer as a complex signal of each subcarrier (Fig.5, Page 190). Xie also teaches of the first wavelet transformer comprising: M-1 single sample delay elements for inputting an in-phase signal and an orthogonal signal output from said LPF (Fig.4, Z^{-1}); M downsamplers for inputting output data of said single sample

delay elements (Fig.4); a first prototype filter for inputting output data of said M downsamplers (Fig.4, r_0 – r_{2M-1}, equation 8, Page 189), ; and a high-speed discrete cosine transformer for inputting output data of said first prototype filter (IFFT and Page 189, equations 6 – 7).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have equalized the complex signal from the wavelet transformer to enable a high rate operation for the wireless channels. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the wavelet transformer configuration of Xie to introduce immunity to narrowband interference without adding complexity to the system.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Aristocratis Fotakis whose telephone number is (571) 270-1206. The examiner can normally be reached on Monday - Thursday 6:30 - 4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chieh M. Fan can be reached on (571) 272-3042. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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AF

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